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L8: Entry 1 of 1 File: USPT Mar 1, 1994

DOCUMENT-IDENTIFIER: US 5290485 A
TITLE: Third-order nonlinear optical element

US Patent No. (1):
5290485

Brief Summary Text (7):
The nonlinear optical effects are those expressed by the high order terms of E, i.e., terms of E of not less than square. The second harmonic generation (SHG) expressed by the second term and the third harmonic generation (THG) expressed by the third term are well known as the effects of frequency conversion. The third term also excerts effects of light intensity dependent optical constants, such as effect of optically induced refractive-index change, nonlinear absorption effect, the second-order electric optical (Kerr) effect and four-wave parametric mixing (phase-conjugated-wave generation) effect, any one of effects is important in the applied optics field.

Detailed Description Text (28):
Preferred examples of the shape of the optical element of the present invention are shown in FIG. 3. In FIG. 3, the input light-impinging surface is designated by the reference numeral 32, and the output light-exitting surface is designated by the reference numeral 34. FIG. 3 (a) shows a single crystal of the charge-transfer complex in the form of parallelpiped, and FIG. 3 (b) shows a single crystal in the form of a cubic. In these cases, any pair of surfaces may be used as the input light-impinging surface and output light-exitting surface. FIG. 3 (c) shows a crystal in the form of a plate having a pair of substantially parallel surfaces. In this case, the substantially parallel surfaces may be used as the input light-impinging surface and output light-exitting surface. The portions other than the two surfaces may have any form (in the illustrated example, the crystal is cylindrical). FIG. 3 (d) shows a crystal in the form of a pillar. The cross section of the pillar may be any shape such as circle, oval, truncated oval and polygonals. In this case, not only the end surfaces 32 and 34, but also the side surface of the pillar may be used as the input light-impinging surface or the output light-exitting surface. FIG. 3 (e) shows a crystal in the form of a curved cylinder. When the diameter of the cylinder is small, this shape is called as a fiber. FIG. 3 (f) shows a crystal in the form of a prism. In this case, the average optical path-length is not less than 0.05 mm. FIG. 3 (g) shows a crystal in the form of a convex lens. In this case, the thickness of the center portion of the lens is not less than 0.05 mm. FIG. 3 (h) shows a crystal in the form of an concaved lens. In this case, the thickness of the center portion of the lens is nog less than 0.05 mm. FIG. 3 (i) shows a crystal in the form of a flat plate. In this case, a single surface may simultaneously act as the input light-impinging surface and the output light-exitting surface. More particularly, a pair of prisms are placed on the plate. After passing through the prism 36, the input light passes through the plate and exits from another prism 38. In using this type of element, for example, a transparent film is placed on the element, and light is introduced into the film using a prism. The nonlinear optical effect may be obtained by the evanescent wave of the light. It is contemplated that such a single surface which acts as the input light-impinging surface and the output light-exitting surface is construed as "two surfaces" in claim 1, and such a mode is also included in the scope of the present invention.

Detailed Description Text (86):
An embodiment of a phase-conjugated-wave generator is shown in FIG. 6. The nonlinear optical element 11 consisting essentially of TCNE/perylene complex obtained in Example 2 is interposed between a half mirror 62 and a totally reflecting mirror 64. The totally reflecting mirror 64 is set perpendicularly to the input light Pi. The half

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The nonlinear optical effects are those expressed by the high order terms of E, i.e., terms of E of not less than square. The second harmonic generation (SHG) expressed by the second term and the third harmonic generation (THG) expressed by the third term are well known as the effects of frequency conversion. The third term also excerts effects of light intensity dependent optical constants, such as effect of optically induced refractive-index change, nonlinear absorption effect, the second-order electric optical (Kerr) effect and four-wave parametric mixing (phase-conjugated-wave generation) effect, any one of effects is important in the applied optics field.

Detailed Description Text (86):
An embodiment of a phase-conjugated-wave generator is shown in FIG. 6. The nonlinear optical element 11 consisting essentially of TCNE/perylene complex obtained in Example 2 is interposed between a half mirror 62 and a totally reflecting mirror 64. The totally reflecting mirror 64 is set perpendicularly to the input light Pi. The half mirror 62 is arranged slant with respect to the optical path of the input light Pi. Another half mirror 62' is placed so as to reflect the light coming from the half-mirror 62 into the element. This structure is called degenerate four-wave mixing (DFWM) constitution. When three lights A.sub.1, A.sub.2 and A.sub.p, here A.sub.1 and A.sub.2 are the pumping lights and A.sub.p is the probing light, impinge on the nonlinear optical element 11, a fourth output signal light Ac, called output phase-conjugated light whose spatial phase term alone is conjugated with the light Ap, is generated. This phase-conjugated wave is drawing attention as a useful mean for image correction and real time holography (as to its application, see "O plus E", March, p.73 (1982)). With this example, the high speed response and the low minimum input light intensity were confirmed.